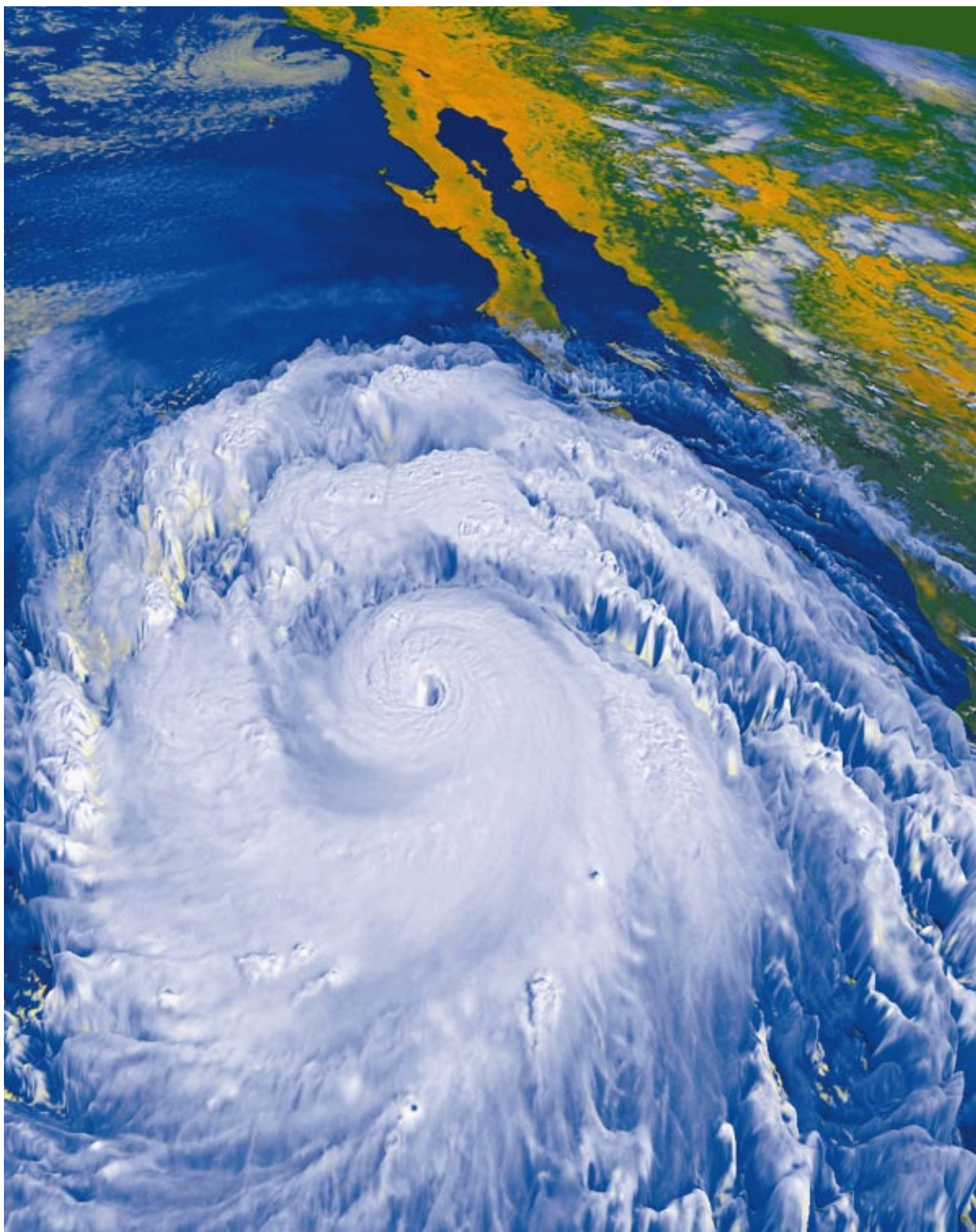




National Aeronautics and
Space Administration
Goddard Space Flight Center

GOES Hurricane Linda





This image of Hurricane Linda was taken from the NOAA/National Weather Services' GOES-9 geostationary satellite as Linda approached Baja California on September 12, 1997 at 18:00 UT (10:00 PST), enhanced and rendered at the NASA Goddard Space Flight Center, Laboratory for Atmospheres, Greenbelt, Md. An approximation of photo-realistic colors were made using the following channels from the GOES-9 spacecraft: the red is derived from the visible, the green is derived from an enhanced version of the visible and the blue is derived from the inverted 11 micrometer infrared channel.

Hurricanes are products of the tropical ocean and atmosphere. Powered by heat from the sea, hurricanes are steered by the easterly trade winds and the temperate westerlies as well as by their own ferocious energy. Around their core, winds grow with great velocity, generating violent seas. Moving ashore, they can produce a tremendous storm surge while spawning tornadoes and producing torrential rains and floods. According to the National Hurricane Center, on average, 10 tropical storms (six of which become hurricanes) develop over the Atlantic Ocean, Caribbean Sea, or Gulf of Mexico each year.

Timely warnings have greatly diminished hurricane fatalities in the United States. NOAA's National Hurricane Center and National Weather Service field offices team up with federal and local agencies, rescue and relief organizations, the private sector, and the news media in the warning and preparedness effort.

The GOES system is a basic element of U.S. weather monitoring and forecast operations and is a key component of the National Oceanic and Atmospheric Administration's (NOAA)'s National Weather Service modernization program. Satellite and ground-based systems work together to provide weather imagery and quantitative sounding data that form a continuous and reliable stream of environmental information for weather forecasting and related services.

The new series of GOES satellites provides significant improvements over the previous GOES system in weather imagery and atmospheric soundings. The enhanced series improves weather services, particularly the timely forecasting of life- and property-threatening severe storms. GOES are the next generation of weather satellites that introduce two new features. The first, flexible scan, offers small-scale area imaging that lets meteorologists take pictures of local weather trouble spots. This allows them to improve short-term weather forecasts over local areas. The second feature, simultaneous and independent imaging and sounding, is designed to allow weather forecasters to use multiple measurements of weather phenomena to increase the accuracy of their forecasts.

GOES data products also are used by commercial weather users, universities, the Department of Defense, NASA, and the global research community.

For 12 years, NASA and NOAA have worked jointly to perfect, develop and complete the GOES program. NASA's GSFC is responsible for the design, procurement, development and verification testing of the spacecraft, instruments and ground equipment. Following deployment of the spacecraft from the launch vehicle, GSFC is responsible for the mission operation phase leading to injection of the satellite into geostationary orbit and initial in-orbit satellite checkout and evaluation.

NOAA is responsible for program funding and the in-orbit operation of the system and also determines the need for satellite replacement. NOAA and NASA jointly design, develop, install, and integrate the ground system needed to acquire, process and disseminate the data from the sensors on the GOES I-M satellites.

Data from the GOES spacecraft is helping NASA scientists design instruments for follow-on missions for NASA's Earth Science Enterprise, a long-term research program designed to study the Earth's land, oceans, air, ice and life as a total system.

FOR THE CLASSROOM

1. GOES-9 provides a constant vigil for weather conditions that can cause turmoil in our lives such as severe storms, hurricanes and tornadoes. To hover over the same area of Earth, GOES operates in a geosynchronous orbit 22,240 miles (35,790 km) above Earth. To help students understand this type of orbit, do the following activity:

Have students work in pairs. Each group of students will need a flashlight and any kind of sticker. One student will represent Earth and the other the GOES satellite. The Earth student will put the sticker on one of their sleeves. The GOES student will hold the flashlight. The students can be challenged to calculate a scale for the distance the GOES student should stand from the Earth student. (It should be reasonable for the room where the activity is taking place.) Challenge the GOES students to keep the beam of the flashlight constantly on the sticker placed on the Earth student as the Earth student rotates on its axis.

What direction should the "Earth" rotate? (counterclockwise)

What direction should the "GOES" rotate? (counterclockwise)

Is a geostationary orbit the best orbit for a weather satellite? Why?

2. Hurricanes are large storms that form in warm, moist, tropical air near the equator in summer and fall. Moisture from warm ocean water evaporates rapidly. Colder air from above moves down and pushes more warm air up. This is called convection; lighter, less dense, warm air rises when it meets dense, heavier, cooler air.

Convection may be observed in water

Materials for each group of students:

400ml beaker, 1/2 cup small paper circles from a hole-punch (colored paper circles are easier to observe), Hot plate, water. Use caution with the hot plate and boiling water! Can be demonstrated for younger students.

Have students fill a beaker with 300ml. water. Place the hole-punch circles in the water. Place the beaker on the hot plate and bring the water to a boil. Have the students observe the behavior of the hole-punch circles and draw a diagram to show how they move.

To check for understanding, ask the following questions:

1. When the water boils, what happens to the hole-punch circles? (They move in a circular pattern.)

2. Why does this happen? (As the water is heated, it rises. As it gets further from the heat source, it cools and then sinks. The heat again causes the water to rise, and the cycle continues. This movement of heat in currents is called convection.)

When this transfer of warm air moving up and cold air moving down begins to spiral around a central core a potential hurricane is born!

For more hurricane images on the World Wide Web:

<http://pao.gsfc.nasa.gov/gsfcc/earth/pictures/earthpic.htm>

<http://globe3.gsfc.nasa.gov/cgi-bin/show.cgi/page=gallery-advanced.htm>